

### REMARKS

In response to the Examiner's Action mailed October 24, 2002, Applicants amend their application and request reconsideration. In this Amendment, non-elected claims 21 and 22 are cancelled leaving claims 1-20 pending.

Claims 8, 9, and 17 were objected to but not rejected. Therefore, no further comment is made with respect to those claims.

Some minor errors in the specification, not previously corrected, are corrected in this Amendment. There is no substantive change in the disclosure and no new matter is introduced.

The examined claims include three independent claims, claims 1, 13, and 18. While there are clearly differences between the structures described in those three independent claims, there is a common feature as well. That common feature is a composite material having a matrix of a dielectric material. Another important component of the composite material comprises nano magnetic particles that are dispersed throughout the matrix, including in the thickness direction of the matrix.

As extensively described in the patent application, the dielectric constant of the composite can be reduced, upon the application of a magnetic field, to a dielectric constant well below the inherent dielectric constant of the matrix material. The patent application includes numerous examples of methods of preparing the particles and then dispersing the particles within the matrix, with several examples of different matrix materials being described. For example, synthesis of nano magnetic particles employed in the invention is described in several examples at pages 7-10 of the patent application.

As described in the patent application, it is essential, to achieve the advantages of the invention, that the nano magnetic particles have a sub-micron size, i.e., a nano scale size, so that they exhibit a magnetic anisotropy characteristic of the shape of the particles rather than of the crystalline material from which the particles are made. Table 2 at page 9 of the patent application provides an example of such particle size ranging from 5.2 to 5.8 nm.

Examples of the manufacture of composite material within the scope of the invention, using the nano particles are described at pages 10-14 of the patent application. In those examples, for example, in the description in the paragraph beginning at page 12, line 5, the composite materials include a matrix having thickness, i.e., a thickness of a film, in the micron range, for example, 40 microns. Thus, in composite materials according to the invention, the layer that is the matrix is at least one thousand times thicker than the dimension of the nano magnetic particles dispersed throughout that matrix. This feature of the invention is incorporated in each of the three independent claims. In addition, claim 6 is clarified and an inadvertent error in claim 11 is corrected. Redundancies in claims 9 and 11 are eliminated.

Examined claims 1, 4, 5, 7, 13, 15, 16, 18, and 20 were rejected as anticipated by Sato et al. (U.S. Patent 6,232,777, hereinafter Sato). This rejection is respectfully traversed, particularly as to the claims now presented.

Sato is concerned with a rather unusual tunneling magnetoresistive element and magnetic sensor. The element includes, in two described embodiments, a single layer of nano magnetic particles interposed between two dielectric films for sensing a tunneling current. The first embodiment of the Sato structure is particularly described in column 5 lines 22-35 and column 6 lines 31-48 of Sato. Particular attention is directed to the first of those descriptions which emphasizes that the nanomagnetic particles 110 form a single-layer. The single layer is formed by immersing the substrate structure in a colloidal solution "so that only a single layer of nanomagnetic particles 110... is deposited on the tunnel barrier layer 310." Therefore, unlike the structure defined by the claims pending in the present patent application in this first embodiment described by Sato, there is no matrix and there is no dispersion of the nano magnetic particles throughout the thickness of the matrix. Instead, there is only a single layer of such particles. In fact, the presence of only a single-layer of particles is critical to the successful operation of Sato's unusual element and sensor.

The second embodiment of the element and sensor described by Sato is described with respect to Figures 7-10A of that patent, beginning at column 7, line 63 and continuing, in pertinent part, through column 8, line 25. In that embodiment, the nano magnetic particles have a diameter of 6nm and are "dispersed" within a matrix 125 of aluminum oxide that has a thickness of 8nm. It is apparent from these dimensions, without even considering Figure 8 of Sato, that it is impossible to have within the aluminum oxide matrix 125 more than a single layer of the nano magnetic particles. The diameter of the particles is three-quarters of the thickness of the aluminum oxide matrix prohibiting formation of more than a single layer of particles. Thus, there is no pertinent difference between the two embodiments described by Sato except that the second embodiment has a thin layer that might be considered a matrix containing the single-layer of nano magnetic particles.

It is apparent that Sato cannot anticipate any claim now pending because Sato lacks the arrangement in which nano magnetic particles are dispersed throughout a dielectric matrix, including in the thickness direction of the dielectric matrix. The dimensional relationship specified in the claims is clearly completely different from and outside the disclosure of Sato. Moreover, Sato depends upon the single-layer of nano magnetic particles in order to measure a tunneling current. Therefore, there cannot even be a suggestion within Sato for the structures defined by the claims now pending. Accordingly, upon reconsideration, the rejection should be withdrawn.

In re Appln. of PARK et al.  
Application No. 09/839,594

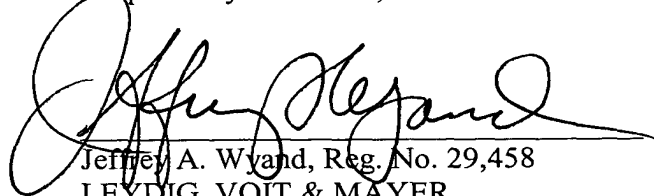
Claims 2, 3, 6, 10-12, 14, and 19 were rejected as unpatentable over Sato in view of Ohtaki (U.S. Patent 6,063,303). This rejection is respectfully traversed.

Ohtaki was relied upon only as potentially disclosing particular shapes of magnetic particles. Ohtaki has nothing to do with nano magnetic particles and is not properly combinable with Sato. Further, the rejection of the dependent claims that is founded upon the combination of Sato and Ohtaki is based upon the assertion that the independent claims are anticipated by Sato. Since that primary rejection can no longer be maintained, the secondary rejection likewise fails.

A number of dependent claims include limitations not disclosed either by Sato or Ohtaki. These claims pertain to using particular materials for the matrix, such as specified in claim 6, particular materials in the magnetic particles, such as specified in claim 11. The Examiner acknowledged that the limitations of these claims are not disclosed in the prior art applied. Nevertheless, the Examiner asserted that one of skill in the art would find it obvious to use such materials. Applicants respectfully traverse this assertion and request, that if the Examiner intends to maintain these rejections, that some prior art reference supporting the assertion be supplied. Otherwise, the rejection should be withdrawn and cannot be properly maintained based upon what appears to be "Official Notice".

Reconsideration and withdrawal of the rejections of claims 1-7, 10-16, and 18-20 is appropriate and earnestly solicited.

Respectfully submitted,



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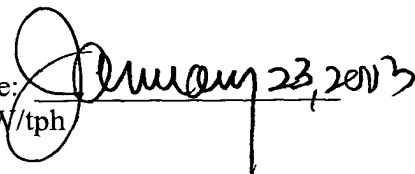
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January 23, 2003



PATENT  
Attorney Docket No. 401182/Y.P. LEE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

PARK et al.

Application No. 09/839,594

Art Unit: 2823

Filed: April 23, 2001

Examiner: K. Nguyen

For: LOW DIELECTRIC COMPOSITE WITH  
NANO MAGNETIC PARTICLES,  
MANUFACTURING METHOD  
THEREOF, AND SEMICONDUCTOR  
DEVICE AND OPTICAL DEVICE  
USING THE SAME

AMENDMENTS TO SPECIFICATION, CLAIMS, AND ABSTRACT  
MADE IN RESPONSE TO OFFICE ACTION DATED OCTOBER 24, 2002

*Amendments to the paragraph beginning at page 2, line 26:*

As an ultra low dielectric constant material having a dielectric constant of 2.5 or less ~~becomes highly has been demanded in the~~ for semiconductor device manufacturing ~~process~~ processes, ~~it is~~ has become necessary to develop a novel ultra low dielectric constant material ~~which can satisfy requirements of that~~ has a low dielectric constant, that is excellent in thermal and mechanical properties, has a low ~~tendency of absorbing~~ absorbance, and has a high electric strength.

*Amendments to the paragraph beginning at page 5, line 23:*

The nano magnetic particles 200 have submicrometer or nano ~~scales~~ scale, so that they do not exhibit ~~a magnetism of crystal~~ having a crystalline anisotropy but exhibit ~~a magnetism of~~ having a shape anisotropy.

*Amendments to the paragraph beginning at page 7, line 14:*

If the introduced nano magnetic particles 200 are ~~greater~~ larger in scale than several ~~nanometer scales~~ nanometers, ~~and do not exhibiting~~ exhibit superparamagnetism, remnant

induction may be caused due to the displacement electric field. Thus, a reduction in the dielectric constant due to an electric field disturbance does not occur.

*Amendments to the paragraph beginning at page 8, line 11:*

A metal salt synthesized in step 1, that is, the anion surfactant, e.g.,  $\text{Fe}(\text{DS})_2$ ,  $\text{Ni}(\text{DS})_2$ , or  $\text{Zn}(\text{DS})_2$ , and a cation surfactant, e.g., ~~dodecyltrimethylammonium~~ dodecyltrimethylammonium chloride (DTAC) were mixed in the ratio shown in Table 1 2, 500 ml of 0.7M aqueous solution of methylamine was added thereto and then agitated violently in the presence of air for 6 hours, thereby preparing a nano magnetic material. If an anion surfactant and a cation surfactant are mixed in a predetermined ratio, the micelles are converted from spherical micelles to ~~ellipsoidal~~ ellipsoidal, cylindrical, needle-like, or lamellate micelles. In such a manner, ~~ellipsoidal~~ ellipsoidal, disk-like, or cylindrical, ~~not spherical~~ i.e., non-spherical, nano magnetic particles were produced.

*Amendments to the paragraph beginning at page 12, line 5:*

The thickness of the acquired film was  $40\mu\text{m}$ , and mechanical properties thereof were evaluated with ASTM D882 apparatus manufactured by Instron. The tensile strength of the film was evaluated by measurement of elongation percentage at a break point, stress at ~~a the~~ the break point, and Young's ~~modules~~ modulus. The thermal properties of the film were evaluated by measurement of glass transition ~~temperate~~ temperature and thermal degradation temperature. The measurement results are shown in Table 6.

*Amendments to the paragraph beginning at page 14, line 15:*

In general, ~~a~~ refractive index is defined by  $n_{21} = \sin\theta_1 / \sin\theta_2$ . Here,  $\theta_1$  is ~~an~~ the angle of incidence of incident rays and  $\theta_2$  is ~~an~~ the angle of refraction of refracted rays. For a given refractive index (n) ~~of a medium under in~~ in vacuum, for simplicity, ~~that is,~~  $n = c/v$  ~~(Here where c~~ is the speed of light ~~under in~~ in vacuum and v is the speed of light in the medium,  $n^2 = \epsilon\mu$  ~~(Here, where  $\epsilon$  is the dielectric constant and  $\mu$  is the permeability permeability.)~~ The dielectric constant of the composite according to the present invention can vary ~~by~~ in response to an externally applied electric field (E). This is mainly because the nano magnetic particles 200 introduced into the composite are superparamagnetic. The magnetization degree of a superparamagnetic material ~~is changed~~ changes according to the intensity and frequency of the ~~external~~ externally applied electric field (E). Thus, as the intensity and frequency of the

~~external-externally applied~~ magnetic field (E) ~~are changed~~ change, the dielectric constant of the composite according to the present invention can ~~be changed~~ change.

*Amendments to existing claims:*

1. (Amended) A composite comprising:  
a layer of a dielectric material having a thickness, as a matrix of the composite; and  
nano magnetic particles contained in having a dimension and dispersed throughout the  
matrix, wherein the thickness is at least one thousand times the dimension.

6. (Amended) The composite according to claim 1, wherein the matrix is selected from the group consisting of polyimide, ~~PMMA~~ polymethyl methacrylate, and methyl silsesquioxane.

9. (Amended) The composite according to claim 8, wherein the diamagnetic nano particles include indium ~~(In)~~.

11. (Twice Amended) The composite according to claim 1, wherein the nano magnetic particles are selected from the group consisting of ~~( $\gamma$ -Fe<sub>2</sub>O<sub>3</sub>)~~  $\gamma$ -Fe<sub>2</sub>O<sub>3</sub>, chromium oxide ~~(CrO<sub>2</sub>)~~, europium oxide ~~(EuO)~~, NiZn-ferrite, MnZn-ferrite, and ~~yttrium~~ yttrium-iron garnet.

13. (Amended) A semiconductor device comprising:  
a semiconductor substrate; and  
an insulator ~~made of~~ disposed on the semiconductor substrate and comprising a  
composite having including a layer of a dielectric material having a thickness, as a matrix of  
the insulator, and nano magnetic particles contained in having a dimension and dispersed  
throughout the matrix, wherein the thickness is at least one thousand times the dimension.

18. (Amended) An optical device comprising:  
a layer of a transparent dielectric material having a thickness, as a matrix; and  
~~a composite having~~ nano magnetic particles contained in dispersed within the matrix,  
wherein the thickness is at least one thousand times the dimension.

In re Appln. of PARK et al.  
Application No. 09/839,594

*IN THE ABSTRACT:*

Replace the Abstract with:

ABSTRACT

A composite containing nano magnetic particles is provided. The composite includes nano magnetic particles in a dielectric matrix. The matrix is made of an inorganic material such as silica, alumina, or hydrosilsesquioxane, or an organic material such as polyimide, polymethyl methacrylate (~~PMMA~~), or methyl silsesquioxane. The nano magnetic particles consist of ( ~~$\gamma$ -Fe<sub>2</sub>O<sub>3</sub>~~)  $\gamma$ -Fe<sub>2</sub>O<sub>3</sub>, chromium oxide (~~CrO<sub>2</sub>~~), europium oxide (~~EuO~~), NiZn-ferrite, MnZn-ferrite, ~~yttrium~~ yttrium-iron garnet, or indium (~~In~~).